

Telecommunications Division Fourth Harmonic Power Analyzer

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This report describes the development of a microprocessor-based instrumentation system to be used in the measurement and analysis of fourth harmonic power generated by the DSN high-power transmitters.

I. Introduction

The requirements of the high-power harmonic analyzer, as well as its physical details, were covered in Ref. 1. The harmonic analyzer design in Ref. 2 describes the ability to predict the accuracy of measurements made on harmonic power, in a multimode waveguide, terminated in other than a matched load.

Initial evaluation of the harmonic analyzer, both in the field and in the laboratory, as well as a detailed description of a minicomputer data reduction system is described in Ref. 3. The success of the minicomputer design resulted in the initiation of a program to develop a self-contained portable microprocessor system, with a primary design goal of reducing required operator skill, increasing measurement accuracy, and reducing measurement and data reduction time by greater than fifty percent.

II. Implementation

A simplified block diagram (Fig. 1) shows the major components used in the development of the portable harmonic analyzer. The design of this instrument has been separated into two efforts, the design of the microprocessor controller, and the design of the RF sensor. The design goals of the microprocessor controller are to eliminate complex operator functions and to improve measurement accuracy. The design goals of the RF sensor are overall amplitude stability of less than 0.5 dB variation over the time required for measurement, a dynamic measurement range of -150 dBm to 30 dBm, and an accuracy of ± 2.5 dB.

The major effort during this period centered on development of the microprocessor instrument interface and the control software. The control software has been

developed using a structured design approach and the INTEL PLM language. The main program flow chart (Fig. 2) shows that the operator has three options. Responding with a letter P initiates the data input routine. This routine prompts the operator to designate starting port number, after which the power meter is configured for a measurement, and the operator is asked to signify when the probe is inserted into the proper port. Data are stored and the next port is identified for the operator. At the completion of data collection, the program notifies the operator that data collection is complete and waits for output command.

Responding with a letter R initiates report output routine. This routine uses data taken on input routine, and with stored voltage standing wave ratio (VSWR) Data, corrects measured power for each port. This information is then output to the thermal printer where each port is identified with its corrected power displayed. The report

is completed with each port power summed and total power printed out. Responding with a letter T initiates the total output routine. This routine, like the report routine, corrects the measured power of each port using stored constants (VSWR, probe gain/loss, frequency), sums all ports, and prints out only total power.

III. Conclusion

The Control Program and Interface bus have been successfully designed and demonstrated in the laboratory (Fig. 3). Operator functions have been reduced to a maximum of three: (1) reading prompt message, (2) inserting probe into proper port, and (3) operating switch signifying to microcontroller that operator task is complete. During the next reporting period the RF sensor design will be completed and the total system accuracy calibrated.

References

1. Smith, R. H., "Fourth Harmonic Analyzer," in *The Deep Space Network Progress Report 42-20*, pp. 121-123, Jet Propulsion Laboratory, Pasadena, Calif., April 15, 1974.
2. *Final Report: JPL Harmonic Analyzer Study Program*, Report No. 953443. Jet Propulsion Laboratory, Pasadena, Calif., October 1972. (JPL internal document.)
3. Grigsby, Y. L., "Automation of Data Gathering and Analysis for the Fourth-Harmonic Analyzer," in *The Deep Space Network Progress Report 42-26*, pp. 126-132, Jet Propulsion Laboratory, Pasadena, Calif., April 15, 1975.

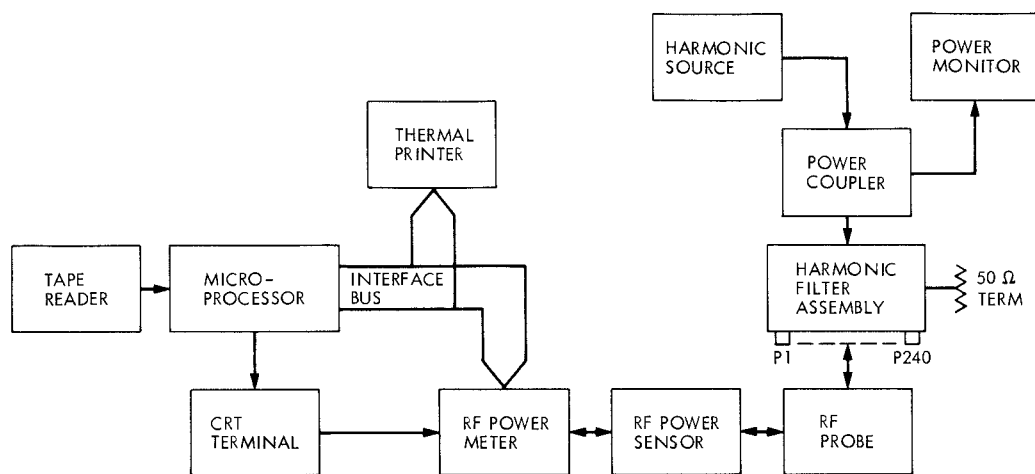


Fig. 1. Harmonic analyzer

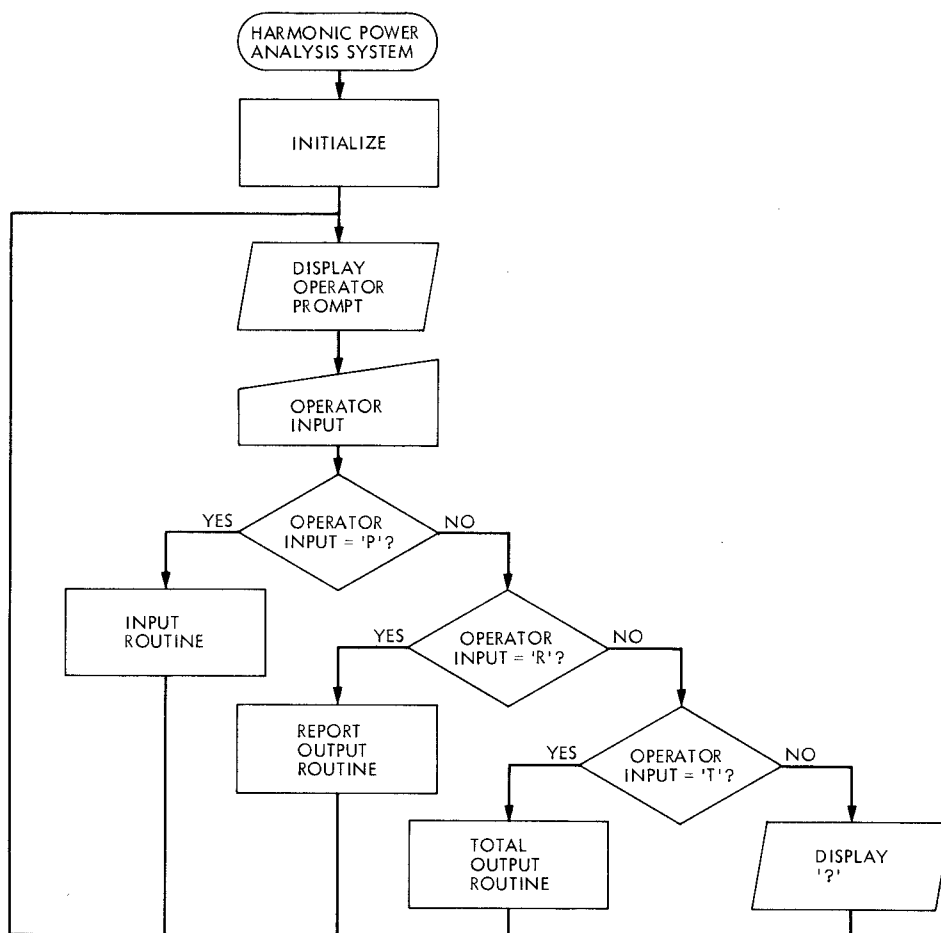


Fig. 2. Main program flow chart

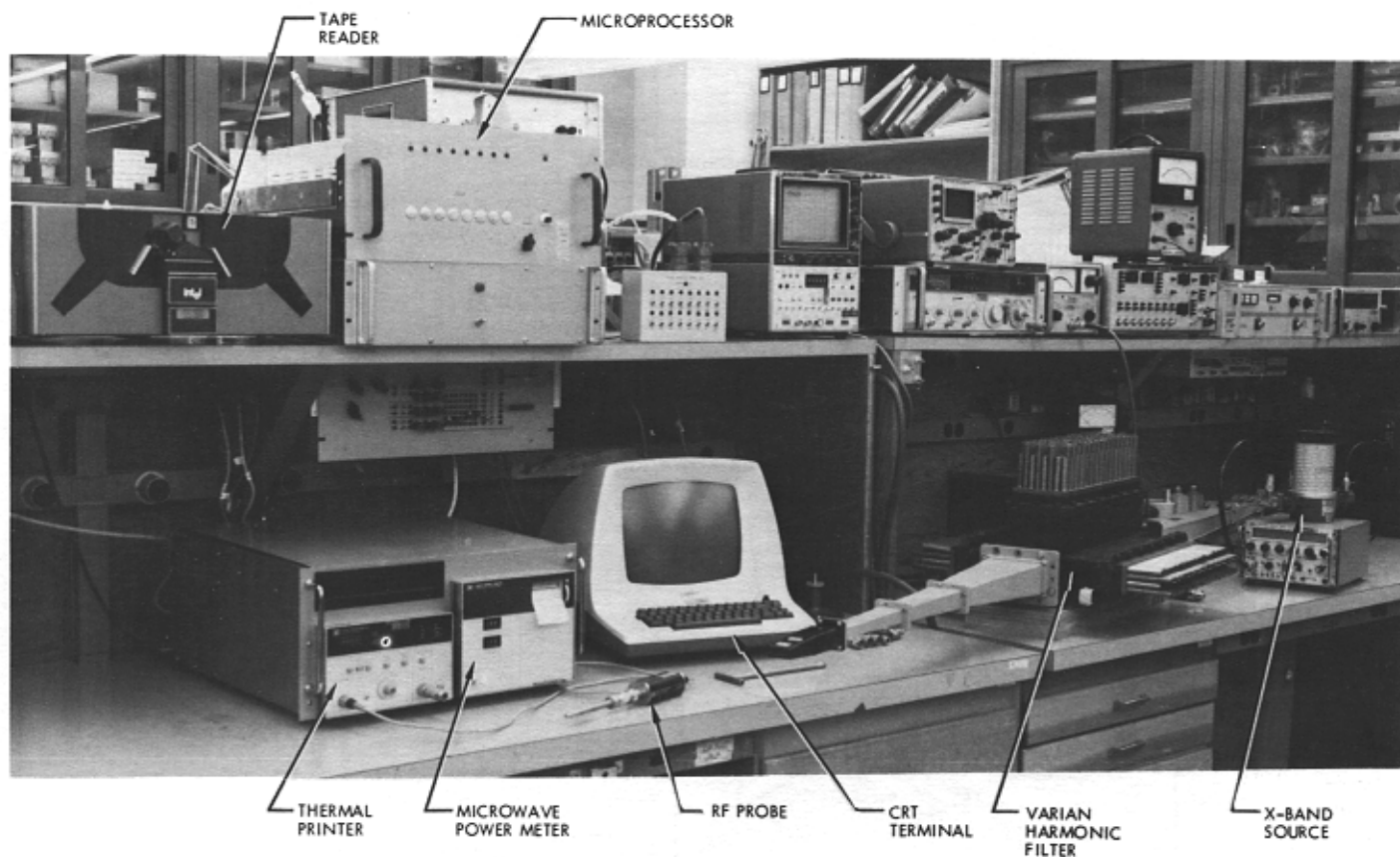


Fig. 3. High-power harmonic analyzer laboratory engineering model